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INPUT SIGNAL SYNTHESIS FOR LINEAR AND NONLINEAR SYSTEM IDENTIFI--ETC(U)  
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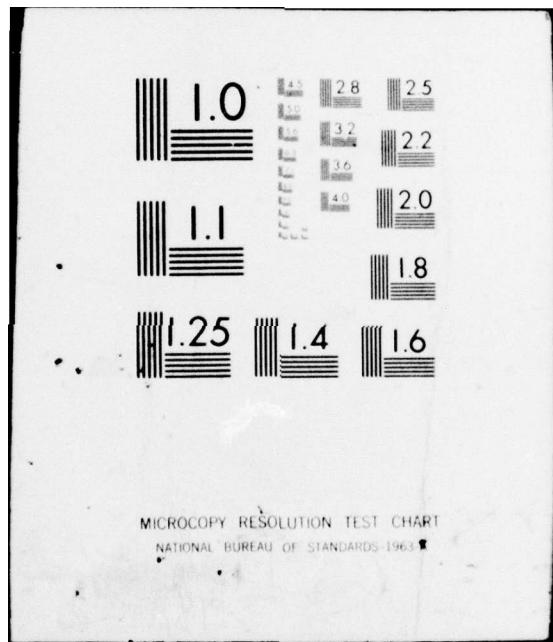
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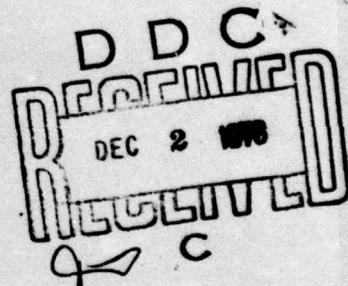
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**INTERIM SCIENTIFIC REPORT**

**June 1, 1975 to June 30, 1976**

**Air Force Research Grant: AF-AFOSR-75-2839**

"Input Signal Synthesis for Linear and  
Nonlinear System Identification"



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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The general subject of this research grant is input signal synthesis for the enhancement of system identification. During the past year, many aspects of the problem have been investigated and several papers have resulted. In this interim progress report, the work that has been done is summarized and synopses of publications are presented.		

## **ABSTRACT**

The general subject of this research grant is input signal synthesis for the enhancement of system identification. During the past year, many aspects of the problem have been investigated and several papers have resulted. In this interim progress report, the work that has been done is summarized and synopses of publications are presented.

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### 1. Summary of Progress

Research during the period from June 1, 1975 through June 30, 1976 has addressed toward three principal problems.

- (1) Analysis and Comparison of Performance Criteria: Substantial effort has been directed to the investigation of interrelationships between different performance measures with particular emphasis placed on the Bhattacharyya distance. A number of interesting theoretical results have been obtained and numerical comparisons of the performance of different input signals have been made.
- (2) Linear System Representations of Input Signals: In an effort to parameterize the input signal and thereby to reduce the computational burden, we have investigated the use of linear models for the generation of input signals. The parameters of the linear system are chosen to shape the spectrum of signal that is generated for use as input to the system being identified.
- (3) Test Bed Development: Because of the intrinsic difficulties involved in the analysis of large-dimensional estimation and control problems, a significant portion of this effort has required numerical studies. We have undertaken the development

of a digital computer program that will serve as a test bed  
for both identification algorithms and input signal synthesizers.

In addition to the detailed research activities alluded to above, some effort has been directed toward more general consideration of the problem and of the tools required to attack the problem. This has led to the preparation of a perspectives paper on the general stochastic control problem of which input signal synthesis is a special case. Because of the numerical optimization requirements of the study, a review of parameter optimization problems has led to the preparation of a series of tutorial articles on nonlinear programming.

In the opinion of the principal investigator, the effort during the past year has proven to be remarkably productive. Certainly, a substantial number of publications have resulted. In the coming year, we have the opportunity to continue the work and to begin to consider new aspects of the problem.

## 2. Publications and Reports Supported by the Grant

The research that has been partially or wholly supported by the grant has led to several publications. We list these documents below and note that copies have or will be forwarded to AFOSR under separate cover.

Ph. D. Dissertation

B. R. Upadhyaya, "Synthesis of Input Signals in Parameter Estimation Problems," University of California, San Diego, December 1975.

Papers

H. W. Sorenson, B. R. Upadhyaya, "Synthesis of Stationary, Stochastic Inputs in Identification Problems," Proceedings of Sixth Symposium on Nonlinear Estimation Theory, San Diego, 1975, pp. 249-253.

H. W. Sorenson, "An Overview of Filtering and Stochastic Control in Dynamic Systems," Chapter 1 in Control and Dynamic Systems: Advances in Theory and Applications, edited by C. T. Leondes, Academic Press, 1976, pp. 1-63.

H. W. Sorenson, "An Introduction to Nonlinear Programming - Part I: Necessary and Sufficient Conditions," Computers and Electrical Engineering, 3, 1976, pp. 1-32.

H. W. Sorenson, "An Introduction to Nonlinear Programming - Part II: The Linear Programming Problem," Computers and Electrical Engineering, 3, 1976, pp. 127-157.

**H. W. Sorenson, B. R. Upadhyaya, "Bayesian Discriminant Approach  
to Input Signal Selection in Parameter Estimation Problems," to be  
published in Information Sciences.**

**H. W. Sorenson, B. R. Upadhyaya, "Synthesis of Linear Stochastic  
Signals in Identification Problems," to be presented at the 1976 IEEE  
Conference on Decision and Control, Clearwater Beach, Florida.**